chapter one

Overview of Green Buildings

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Introduction

This chapter presents an overview of green buildings and is divided into three sections. The first section discusses what makes buildings green and gives several definitions of green building. The second section discusses the environmental impacts of traditional buildings and explains common green building practices with respect to siting, energy efficiency, water efficiency, building materials, occupant health and well-being, and construction and demolition waste. The third section discusses the role of lawyers in the green building field.

This chapter provides a brief overview of issues that are discussed in more detail in subsequent chapters. Citations to these later chapters are included where applicable.

What Makes Buildings Green?

The beginning of the twenty-first century has ushered in the era of green buildings. According to some estimates, there are approximately 81 million buildings in the United States.[1] Most of these buildings use energy inefficiently, generate large amounts of waste in their construction and operation, and emit large quantities of pollutants and greenhouse gases. In contrast to conventional buildings, green buildings seek to use land and energy efficiently, conserve water and other resources, improve indoor and outdoor

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air quality, and increase the use of recycled and renewable materials. While green buildings still constitute a tiny subset of existing buildings, their numbers are increasing rapidly. In November 2006, the U.S. Green Building Council, the nonprofit group responsible for the creation of the Leadership in Energy and Environmental Design (LEED) green building rating system, announced that 623 buildings had achieved some level of LEED certification.[2] As of December 2009 this number had grown to more than 2,400, and over 35,000 buildings were in the process of achieving some level of LEED certification.[3]

Definitions of "Green Building"

While the definition of what constitutes a green building is constantly evolving, the Office of the Federal Environmental Executive offers a useful working definition. This agency defines this term as:

> the practice of (1) increasing the efficiency with which buildings and their sites use energy, water, and materials, and (2) reducing building impacts on human health and the environment, through better siting, design, construction, operation, maintenance, and removal—the complete building life cycle.[4]

Similarly, the Environmental Protection Agency (EPA) defines green building as follows:

> [T]he practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or 'high performance' building.[5]

Both of these definitions mention life cycle assessment (LCA). LCA is the investigation and valuation of the environmental, economic, and social impacts of a product or service. In the context of green buildings, LCA evaluates building materials over the course of their entire lives and takes into account a full range of environmental impacts, including a material's embodied energy; the solid waste generated in its extraction, use, and disposal; the air and water pollution associated with it; and its global-warming potential. LCA is an important tool because it can demonstrate whether a product used in a green building is truly green.[6] LCA is discussed in more detail in Chapter 9.

The Most Important Element: The Efficient Use of Energy

Buildings can incorporate many green features, but if they do not use energy efficiently, it is difficult to demonstrate that they are truly green. In fact, given that the term "green building" can be somewhat vague, some people prefer to use the term "high performance building." A high-performance building is a building whose energy efficiency and environmental performance is substantially better than standard practice.[7]

Although green buildings, on average, use less energy than conventional buildings, energy efficiency remains elusive. In fact, there is a growing debate whether buildings that achieve some level of LEED certification are more efficient in their use of energy than regular buildings.[8] Fortunately, there are numerous ways to improve a building's energy efficiency, from insulating walls to installing automatic shutoff switches for lights. Energy efficiency can be and often is mandated by local and state energy codes, which require that new and substantially renovated buildings comply with increasingly stringent energy efficiency requirements.[9] It suffices to say that if a building is not energy-efficient, it cannot be said to be green.

The Reality of the Built Environment: The Problem of Existing Buildings

Although green buildings represent the next phase of buildings, the reality is that the vast majority of buildings are not green, and these buildings will continue to be used for many years to come. Improving the energy efficiency of existing buildings typically involves a process called retrofitting, which can mean anything from installing more energy-efficient fixtures to increasing the amount of insulation in a building. The U.S. Green Building Council has a rating standard specifically focused on existing buildings, referred to as LEED-EBOM (EBOM stands for "existing buildings operation and maintenance").[10] While greening existing buildings does not receive the attention that new green buildings do, it is certainly more important when looking at reducing the environmental impacts of buildings nationwide.

Impacts of Conventional Buildings That Green Buildings Seek to Rectify

The environmental impacts of buildings are enormous. Conventional buildings use large amounts of energy, land, water, and raw materials for their construction and operation. They are responsible for large greenhouse gas (GHG) emissions as well as emissions of other harmful air pollutants. They also generate large amounts of construction and demolition (C&D) waste and have serious impacts on plants and wildlife. An analysis of these issues demonstrates the scope of the problem.

Energy Use in Buildings

Worldwide, buildings consume massive amounts of energy. The United Nations Environment Programme has reported that 30–40 percent of all primary energy produced worldwide is used in buildings.[11] In 2008, the International Energy Agency released a publication that estimated that existing buildings are responsible for more than 40 percent of the world's total primary energy consumption and for 24 percent of global CO_2 emissions.[12]

The picture in the United States is strikingly similar. In 2004, EPA found that buildings account for 39 percent of total energy use and 68 percent of total electrical consumption.[13] According to the U.S. Department of Energy (DOE), in 2006 buildings in the United States used 74.2 percent of all electricity generated.[14] A report by the U.S. Energy Information Agency (EIA) estimated that 60 percent of the nation's electrical production is utilized to operate commercial buildings, which include those used for education, mercantile, office, storage, and warehouse purposes.[15] By any measure, buildings are responsible for using much of the energy produced today.

In addition, energy consumption is rising. In 2007, DOE projected that energy use in the United States will increase by approximately 19 percent by 2025.[16] But that is only half of the problem. Not only does this country use a lot of energy, it does so inefficiently. America uses twice as much energy per unit of economic output as Germany, and nearly three times as much as Japan.[17]

Fortunately, there are many ways to improve a building's energy efficiency. Simple measures such as weatherstripping, maintaining entry door closers, and installing storm windows as a low-cost alternative to replacements are usually the low-hanging fruit in weatherization. In addition, adding insulation materials to new and existing frame construction buildings is a proven and relatively inexpensive way to improve building energy efficiency with respect to heating and cooling. New innovations in insulation can reduce the energy used in manufacturing insulation and allow insulation to be recycled or biodegradable. Mineral, fibrous, and cellulose-derived materials are now available for insulation purposes.

Another large user of energy is a building's heating, ventilation, and air-conditioning (HVAC) system. Properly designed and installed HVAC systems can reduce the amount of energy used for heating and cooling a building. An HVAC system includes a heater, air conditioner, and fan in one system and operates at a partial load nearly all the time. The design of the HVAC system as a whole-system mechanism saves energy by monitoring airflow and keeping the indoor temperature fairly constant. An HVAC system must have a correctly designed distribution system to minimize the amount of airflow (and thus energy) necessary to heat and cool the building. In addition, allowing building occupants to individually control heating and cooling in their living or working spaces is an effective way to reduce energy use.

Electric lighting consumes about one-quarter to one-third of the energy in a typical commercial building.[18] Lighting also generates heat, so reducing the amount of energy consumed for lighting through effective and efficient lighting also reduces the size of a building's air-conditioning plant. Building information modeling (BIM) enables building design and construction teams to draw and test the building's operating systems, such as electricity or hot water, in one computer model. Modeling buildings with BIM can aid in quantitative energy analysis, connecting complex systems and allowing more precise analysis for better energy use.

Greenhouse Gas Emissions and Indoor Air Pollution

Given that buildings use large amounts of energy, and given that most of this energy comes from the burning of fossil fuels, it is not surprising that buildings in the United States are responsible for many millions of tons of GHG emissions annually. DOE has estimated that in 2006, buildings in the United States emitted 630 million metric tons of GHG emissions, approximately equal to the combined emissions of the United Kingdom, France, and Japan.[19] U.S. buildings by themselves emit more GHGs than any other country in the world except China.[20] On a percentage basis, buildings in the United States are responsible for approximately 40 percent of the country's total GHG emissions.[21]

Unfortunately, greenhouse gases are not the only harmful pollutants that buildings emit. Indoor levels of air pollution may greatly exceed outdoor levels. Indoor air pollution is particularly important given that we spend most of our time indoors. The EPA has estimated that indoor levels of pollution may be two to five times higher, and occasionally more than 100 times higher, than outdoor air pollution levels.[22] This pollution can come from a wide variety of sources.

One way to reduce the presence of these toxins is to ensure that indoor air is frequently replaced by outdoor air and to ensure that this outdoor air is properly filtered.[23] Unfortunately, buildings are often poorly ventilated and do not sufficiently filter the air that is recirculated, leading to air that is potentially harmful to building occupants' health. It has been estimated that the annual cost of building-related sickness is $58 billion.[24]

A primary consideration of green buildings is the health and well-being of their occupants. Many older buildings suffer from what is commonly referred to as "sick building syndrome." According to the EPA, this term is used to describe situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified.[25] Causes of sick building syndrome typically include inadequate ventilation, chemical contaminants from indoor and outdoor sources, and biological contaminants such as mold. The first step in eliminating the causes of sick building syndrome is carefully choosing the materials that are used in the building. Construction materials and interior finish products should be chosen that emit zero or low levels of volatile organic compounds (VOCs), which are harmful to humans and can vaporize at room temperature in a process called "off-gassing."

Another important step in eliminating the causes of sick building syndrome is the building's design. Green buildings are typically designed to provide adequate ventilation of air into them as well as filtration of this air to remove hazardous particles. Ventilation provides for the dilution of indoor air pollutants. In general, increasing the rate at which outdoor air is supplied to a building decreases the effect of these pollutants. Building ventilation can be done by natural or mechanical means. Air moves into and out of naturally ventilated buildings through windows, doors, vents, and other openings incorporated into the building design. Mechanical ventilation is accomplished by using HVAC systems to ventilate buildings.

Building Water Use

As is the case with energy, buildings use staggering amounts of water during their operation. DOE has estimated that, collectively, buildings in the United States (both commercial and residential) use over 38 billion gallons of water *per day*.[26] In many parts of the United States, particularly the southwest, water has become an increasingly scarce resource.[27] As with energy, buildings not only use a lot of water, they also do so inefficiently. For instance, a traditional urinal uses about one or more gallons per flush, and a traditional toilet uses approximately 3.5 gallons per flush. In comparison, ultra-low water urinals use only 0.125 gallons of water per flush, while waterless urinals use none.[28] Similarly, high-efficiency toilets use between 1.2 and 1.6 gallons of water or less per flush.[29]

Further, wastewater from buildings typically goes into municipal sewer systems rather than being treated on-site or used for non-potable purposes. Buildings also usually displace vegetation that can capture and absorb precipitation. The net result is that municipal sewer systems are often overburdened. During rainfall events, billions of gallons of water flow into these sewer systems as runoff, carrying contaminants with them. Many older municipalities have combined sewer systems that capture both storm water runoff and wastewater from buildings. These combined sewer systems are not designed to treat the massive amounts of water that flow into them during heavy rainfall events. Thus, they are equipped with combined sewer overflows (CSOs), which act as safety valves and deposit much of this water, which contains raw sewage and other contaminants, into waterways. In New York City, precipitation of just 0.25 inches can trigger discharges from CSOs into surrounding waterways. The New York City metropolitan area averages about 45 inches of rain annually and has numerous rainfall events of more than 0.25 inches each year.[30]

As is more fully explained in Chapter 10, there are many strategies for conserving water in buildings, as well as reducing the amount of wastewater that ultimately flows into sewer systems. One of the primary uses of water in a building is for toilets, sinks, showers, and similar uses. The byproduct of these uses is wastewater. Reducing the amount of wastewater in a building chiefly depends on a change in the occupants' water usage patterns—namely, the amount of water that is used for things like flushing toilets and urinals. Improved technology and fixture changes, such as low-flow fixtures on faucets and showerheads, can reduce the consumption of water per use. Bathrooms can be installed or retrofitted with low-flow or waterless urinals and toilets that use considerably less water for flushing. Dual-flush toilets that use less water for liquid than solid waste are also available.

Another water-related problem in buildings is storm water runoff. As previously explained, buildings exacerbate this runoff because they reduce the amount of porous surface available to absorb precipitation. However, runoff from roofs, paved areas, or other impervious surfaces can be put to beneficial use. Buildings and landscapes can be designed to maximize the amount of catchment area, and water can be collected in cisterns, barrels, or swales. The collected water can be detained, retained, and routed for use in building evaporative coolers and toilets, and for irrigation purposes.

"Gray water" can also be used in building operations. Gray water is water drained from baths, showers, washing machines, and sinks that can be captured and used again. Gray water can be collected and reused for irrigating landscapes. Gray water may actually benefit plants because it often contains nutrients such as phosphorus. A dual-plumbing system is necessary for recycling gray water within a building. Dual-plumbing systems have separate lines for fresh, gray, and black water,[31] which, because of the added cost, could make this impractical in some buildings. Gray water systems vary from simple, low-cost systems to highly complex ones that include settling tanks and sand filters.

Biological wastewater treatment can also be used to recycle gray and black water. Constructed wetlands are designed to mimic natural wetlands and use plants and microorganisms to treat bacteria and effluent. Wetland plants naturally filter water and break down wastes and solids. Water is designed to flow through at least three wetland cells, which can clean water as well as mechanical or chemical wastewater treatment techniques. Wetland systems can be designed to treat water at many scales, from an entire community to a single home. Biological filtering techniques can also be used in the landscape to remove silt and pollutants from surface runoff. Vegetated infiltration basins, bioswales, and flow-through planters are all examples of techniques that filter runoff before it enters the ground or is used for other applications.[32]

Water use in buildings is discussed in more detail in Chapter 11.

Land Use and Consumption

Many millions of acres of land in this country have buildings constructed on them. According to the National Resources Inventory, approximately 107 million acres of land in the United States are developed.[33] Although buildings themselves use large amounts of land, this is not the primary issue. Rather, it is the poor siting of buildings that leads to large amounts of land (and other resources) being consumed. For example, buildings that are not built in existing residential or commercial areas require the construction of new roads, sewer lines, utility poles, and other infrastructure to reach them, which can lead to, among other things, habitat destruction. In addition, many buildings are not reachable by public transportation and thus require the construction of parking lots or garages.

Most significantly, buildings that are built on the fringes of existing urban or suburban areas often contribute to the problem of sprawl. Although sprawl can have many definitions, generally speaking, sprawl is the spreading of a city or, more typically, its suburbs to previously undeveloped or lightly developed areas. Between 1982 and 1997, approximately 25 million acres (39,000 square miles) of rural land—which includes forest, rangeland, pastures, cropland, and wetlands—were developed. From 1970 to

1990, the 100 largest urbanized areas in the United States expanded over an additional 14,545 square miles.[34] Sprawl and its effects are more fully discussed in Chapter 8.

Green buildings can address the problems of sprawl. Finding or determining an appropriate site is normally the first step in the design process of a green building. Ideally, the site for a green building should be strategically located so it is close to mass transit and fits into the master plan of a community to reduce car dependency and sprawl. The building's site should encourage pedestrian and bicycle use with accessible paths and sidewalks. If possible, sites that currently have existing buildings on them should be used, given that they are often in existing commercial or residential areas.

After a site is chosen, the development process should minimize land disturbance and erosion. The site can be graded to accommodate runoff and prevent damage to the surrounding ecosystem. Geotextiles and silt fences can be used during construction to prevent erosion. Light, shade, wind, and water should be considered when designing the building's envelope, windows, and utilities to take full advantage of the conditions of the site. Landscape elements should include native plants as alternatives to conventional grass lawns, which often depend on irrigation and pesticides. Native plants are adapted to the natural hydrology, climate, and geography of the region and have evolved in relation to other local plants. This allows native plants to provide habitat for local species. Also, native plants normally require less watering, fertilizers, and pesticides.

Site selection and land use planning are discussed in more detail in Chapter 8.

Construction Materials

Building construction is a multibillion-dollar industry and requires the constant production and harvesting of millions of tons of a variety of raw materials to meet worldwide demand. By any measure, the amount of raw materials used in buildings is mammoth. Worldwide, construction activities consume 3 billion tons of raw materials each year, and it has been estimated that the construction industry consumes half of all products produced by volume.[35] In the United States, buildings account for 40 percent of all raw materials used by volume.[36]

A crucial part of green buildings is the material that is used in their construction. Although definitions vary, green building materials are generally composed of renewable rather than nonrenewable resources and are environmentally responsible because their impacts are considered over the life of the product. In addition, green building materials generally result in reduced maintenance and replacement costs over the life of the building, conserve energy, and improve occupant health and productivity. Green building materials can be selected by evaluating characteristics such as reused and recycled content, zero or low off-gassing of harmful air emissions, zero or low toxicity, sustainably and rapidly renewable harvested materials, high recyclability, durability, longevity, and local production.

Green materials and construction are discussed in more detail in Chapter 9.

Construction, Operation, and Demolition Waste

Building C&D waste in the United States totals approximately 136 million tons annually, accounting for nearly 60 percent of total non-industrial waste generation. By way of comparison, the entire amount of municipal waste generated in the United States every year totals 209.7 million tons.[37] According to some estimates, four tons of waste are typically deposited into a landfill during the construction of a new 2,000-square-foot home.[38] Construction waste consists primarily of lumber and manufactured wood products (35 percent), drywall (15 percent), masonry materials (12 percent), and cardboard (10 percent). The remainder is a mix of roofing materials, metals, plaster, plastics, foam, insulation, textiles, glass, and packaging.[39] Although much of this material is recyclable, most of it is deposited into landfills.[40]

Green buildings generally seek to minimize the amount of C&D waste they generate. One way they do this is by recycling or reusing C&D waste, such as by using inert demolition materials as base material for parking lots and roadways. For sites that include the demolition of existing structures, plans can be developed early in the design process to manage and reuse as much material as possible through the deconstruction, demolition, and construction processes. Demolition generates large amounts of materials that can be reused or recycled—principally wood, concrete and other types of masonry, and drywall. Rather than demolishing an entire building, all or part of a building can be deconstructed. Building deconstruction is the orderly dismantling of building components for reuse or recycling. In contrast to building demolition, deconstruction involves taking apart portions of buildings or removing their contents with the primary goal being reuse.

Strategies to reduce C&D waste are discussed in more detail in Chapter 9.

The Role of Lawyers in Green Building

Because green buildings are a relatively new phenomenon, there have been relatively few reported decisions that involve green building–related disputes.[41] However, there are a number of issues unique to green building that are likely to become the subject of litigation in the near future. For example, what party is responsible if a building loses green building tax credits because of construction delays?[42] On a more fundamental level, are laws that mandate certain green building standards unconstitutional if they delegate legislative functions to non-legislative branch entities?[43]

Perhaps the most common issue faced by contractors, design professionals, and owners is that they fail to understand that there is a difference between a normal construction project and a green construction project. Consequently, parties often rely on standard contracts that do not necessarily address the risks unique to such projects. Failure to recognize such risks creates the potential for disputes and litigation at some point in the process.[44]

Many legal issues involving green buildings will likely be familiar ones—e.g., drafting and negotiating of contracts and leases for green buildings, advising clients regarding applicable green building laws and incentives, and litigating liability issues, to name a few. However, many legal issues will be entirely new. For example, how will buildings be affected by economy-wide cap-and-trade greenhouse gas regulations that may be adopted in the near future? How will buildings adapt to the effects of climate change, and what laws will need to be put into place to ensure that building infrastructure is properly protected? What laws and regulations will need to be adopted to ensure that buildings will continue to become more energy-efficient and more reliant on renewable sources of energy? These and many more issues have yet to be fully addressed, and attorneys will play a crucial part in answering them.

This book provides an overview of green building law from a variety of well-known attorneys and other professionals in the green building field. These legal issues are likely to evolve quickly—and perhaps radically—in the coming years. Lawyers who read this book can expect to become better acquainted with the concept of green buildings; the wide variety of laws, regulations, and policies that are involved in their creation and development; and the legal issues that should be analyzed and considered. But like any emerging legal field, particularly one that touches on other legal fields that are themselves rapidly emerging, this book can only briefly touch on many topics. Lawyers who wish to practice in this field would be well advised to acquaint themselves with the ideas set forth in this book, but should consider this book a starting rather than an ending point.

Notes

1. U.S. Dept. of Energy Buildings Technology Program, Obama Administration Launches New Energy Efficiency Efforts (June 29, 2009), *available at* http://www1.eere.energy.gov/buildings/news_detail.html?news_id=12607.

2. Jerry Yudelson, *Where Are All the LEED Projects?*, Table 2 (July 12, 2007), *available at* http://www.sustainablefacility.com/Articles/Leed/BNP_GUID_9-5-2006_A_10000000000000134921. LEED is discussed in more detail in Chapter 2.

3. *See* U.S. Green Building Council, *About USGBC*, *available at* http://www.usgbc.org/DisplayPage.aspx?CMSPageID=124.

4. Office of the Federal Environmental Executive, The Federal Commitment to Green Building: Experiences and Expectations, *available at* http://www.ofee.gov/sb/fgb_report.asp.

5. EPA, Green Building, *available at* http://www.epa.gov/greenbuilding/pubs/about.htm.

6. In May 2008, the International Organization for Standardization (ISO) released a set of principles for evaluating building products throughout their life cycle. The standard, referred to as Sustainability in Building Construction—General Principles (ISO 15392:2008), is available for purchase at http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=40432.

7. *See* U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *About High Performance Buildings*, *available at* http://www.eere.energy.gov/buildings/highperformance/design_approach.html.

8. *See, e.g.,* Henry Gifford, A Better Way to Rate Green Buildings: LEED Sets the Standard for Green Building, But Do Green Buildings Actually Save Any Energy? (2008). In the new update to the four primary LEED rating systems (new construction, existing buildings, commercial interiors, and core and shell), energy efficiency now accounts for more than one-third of all possible points. In addition, the LEED rating systems have upgraded to

a more current energy efficiency standard—the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) Standard 90.1-2007.

9. For example, The New York State Energy Conservation and Construction Code, otherwise known as the State Energy Code and most recently updated in April 2008, encompasses commercial provisions based on the text of the International Energy Conservation Code (IECC) 2003 and ASHRAE 90.1-2004. All building-related codes in New York are currently reviewed and updated on a three-year cycle.

10. Retrofitting and LEED-EBOM is discussed in more detail in Chapter 11.

11. U.N. Environment Programme, *Buildings and Climate Change: Status, Challenges and Opportunities* 4 (2007), *available at* http://smap.ew.eea.europa.eu/media_server/files/R/S/UNEP_Buildings_and_climate_change.pdf.

12. International Energy Agency, Promoting Energy Efficiency Investments: Case Studies in the Residential Sector, at 2 (2008).

13. U.S. Environmental Protection Agency, *Buildings and the Environment: A Statistical Summary* (Dec. 2004), *available at* http://epa.gov/greenbuildings/pubs/gbstats.pdf.

14. U.S. Dept. of Energy, 2008 Buildings Energy Data Book (Sept. 2008), *available at* http://buildingsdatabook.eere.energy.gov/docs%5CDataBooks%5CSEP_2008_BEDB.pdf.

15. *See* U.S. Energy Information Admin., *Commercial Buildings Energy Consumption Survey*, *available at* http://www.eia.doe.gov.

16. U.S. Dept. of Energy, Energy Information Administration, *Annual Energy Outlook 2008* (Dec. 2007).

17. U.S. Dept. of Energy, Energy Information Administration, *Annual Energy Review 2005* (June 2006).

18. *See* Energy Star, Lighting (Energy Star Buildings Manual), at 1, *available at* http://www.energystar.gov/ia/business/BUM_lighting.pdf.

19. *Annual Energy Outlook 2008*, *supra* note 16. *See generally* Global Climate Change and U.S. Law (Michael B. Gerrard ed., Am. Bar Ass'n 2007).

20. Kinzey, The Federal Buildings Research and Development Program: A Sharp Tool for Climate Policy, 2000 ACEEE Proceedings, Sec. 9.21.

21. U.S. Environmental Protection Agency, Buildings and the Environment: A Statistical Summary (Dec. 2004), *available at* http://epa.gov/greenbuilding/pubs/gbstats.pdf. In 2008, the International Energy Agency released a publication, *Promoting Energy Efficiency Investments: Case Studies in the Residential Sector*, which estimated that existing buildings are responsible for more than 40 percent of the world's total primary energy consumption and for 24% of global CO_2 emissions. The publication is available at http://iea.org/w/bookshop/add.aspx?id=326.

22. M. Baum, Green Building Research Funding: An Assessment of Current Activity in the United States 1 (2007). *See also* Environmental Law Practice Guide, ch. 17C (M. Gerrard ed.) (LexisNexis Matthew Bender).

23. It should be mentioned that filtering air significantly increases building energy use.

24. *See* Green Building in North America: Opportunities and Challenges (Comm. for Env. Cooperation 2008), *available at* http://www.cec.org/files/PDF//GB_Report_EN.pdf.

25. Indoor Air Facts No. 4 (Revised): Sick Building Syndrome (EPA Feb. 2008), *available at* http://www.epa.gov/iaq/pubs/sbs.html.

26. *See* U.S. Dept. of Energy, Buildings Energy Data Book, Table 8.1.1 (Sept. 2008), *available at* http://buildingsdatabook.eere.energy.gov/docs/xls_pdf/8.1.1.pdf.

27. In some parts of the United States, water levels in aquifers have dropped more than 100 feet since the 1940s. On an annual basis, the water deficit in the United States is estimated to be about 3,700 billion gallons, meaning that Americans extract 3,700 billion gallons per year more than they return to the natural water system to recharge aquifers and other water sources.

28. A waterless urinal utilizes a trap insert filled with a sealant liquid instead of water. A sealant that is lighter than water floats on top of the urine collected, preventing odors from being released into the air. Although the cartridge and sealant must be periodically replaced, it is estimated that waterless urinals save anywhere between 25,000 and 35,000 gallons of water per urinal per year. *See* J. Allen, *Going Green Pays Off*, BUILDINGS MAGAZINE (July 2004).

29. *See* EPA WaterSense, High Efficiency Toilet Questions, *available at* http://www.epa.gov/watersense/fq/het.htm.

30. *See* Volume of New York City's Annual Precipitation, *available at* http://hypertextbook.com/facts/2005/LauraDePalma.shtml.

31. Black water is water that contains fecal matter or urine.

32. For example, Portland, Oregon, uses many innovative and environmentally sound techniques to control storm water runoff that have been successful at a micro and macro scale. *See* http://www.portlandonline.com/bes/index.cfm?c=43110&a=129057.

33. U.S. ENVIRONMENTAL PROTECTION AGENCY, BUILDINGS AND THE ENVIRONMENT: A STATISTICAL SUMMARY (Dec. 2004), *available at* http://epa.gov/greenbuilding/pubs/gbstats.pdf.

34. L. KOLANKIEWICZ & R. BECK, WEIGHING SPRAWL FACTORS IN LARGE U.S. CITIES, at 15 (March 2001), *available at* http://www.sprawlcity.org/studyUSA/USAsprawlz.pdf.

35. O. Hansen, Green Buildings: Small Business Innovation Research Special Solicitation Workshop (EPA March 2004).

36. Autodesk, Inc. 2005, Building Information Modeling for Sustainable Design, *available at* http://www.federalnewsradio.com/pdfs/BuildingInformationModelingforSubstainableDesign-white%20paper.pdf.

37. BUILDINGS AND THE ENVIRONMENT: A STATISTICAL SUMMARY (EPA Dec. 2004), *available at* http://epa.gov/greenbuilding/pubs/gbstats.pdf.

38. ECO-WISE 2008, CONSTRUCTION WASTE: A SOURCEBOOK FOR GREEN AND SUSTAINABLE BUILDING, *available at* http://www.greenbuilder.com/sourcebook/ConstructionWaste.html.

39. Nebraska Energy Office, *Construction Waste Minimization Methods*, *available at* http://www.neo.ne.gov/home_const/factsheets/const_waste_min.htm.

40. Sustainable Sources, *Construction Waste Recycling*, *available at* http://constructionwaste.sustainablesources.com.

41. One such decision, *AHRI v. City of Albuquerque*, 2008 U.S. Dist. LEXIS 106706, *2 (D. N.M. Oct. 3, 2008), is discussed at length in Chapter 14.

42. This issue is also discussed in Chapter 14 in the context of Maryland's Green Building Tax Credit Program.

43. This issue is discussed in more detail in Chapter 4.

44. This issue is discussed in more detail in Chapter 9.